

Original Paper

Neurological Disorders in Central Spain, Second Survey: Feasibility Pilot Observational Study

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Abstract

Background: The Neurological Disorders in Central Spain, second survey (NEDICES-2) is a population-based, closed-cohort study that will include over 8000 subjects aged ≥ 55 years. It will also include a biobank.

Objective: The objective of this study was to evaluate all major aspects of the NEDICES-2 (methods, database, screening instruments, and questionnaires, as well as interexpert rating of the neurological diagnoses) in each one of the planned areas (all of them in central Spain) and to test the possibility of obtaining biological samples from each participant.

Methods: A selection of patients and participants of the planned NEDICES-2 underwent face-to-face interviews including a comprehensive questionnaire on demographics, current medications, medical conditions, and lifestyle habits. Biological samples (blood, saliva, urine, and hair) were also obtained. Furthermore, every participant was examined by a neurologist.

Results: In this pilot study, 567 study participants were enrolled (196 from hospitals and 371 from primary care physician lists). Of these 567, 310 completed all study procedures (questionnaires and the neurological evaluation). The study was time-consuming for several primary care physicians. Hence, a few primary care physicians from some areas refused to participate, which led to a reconfiguration of study areas. In addition, the central biobank needed to be supplemented by the biobanks of local Spanish National Health System hospitals.

Conclusions: Population-based epidemiological surveys, such as the NEDICES-2, require a pilot study to evaluate the feasibility of all aspects of a future field study (population selection, methods and instruments to be used, neurological diagnosis agreement, and data collection).

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KEYWORDS

dementia; essential tremor; headache; longitudinal study; mild cognitive impairment; NEDICES; observational study; Parkinson's disease; pilot study; population-based study; stroke

Introduction

A pilot study is usually recommended before undertaking epidemiological research in large populations to study neurological, psychiatric, or aging-related diseases [1-9]. Surveys investigating neurological diseases are especially difficult because of the need for an expert diagnosis, as a sizable proportion of neurological disorders do not have diagnostic biomarkers [10]. The difficulty increases when epidemiological surveys require upfront screening to obviate the workload of a 2-phase survey [2]. In this type of neurological research, pilot studies prior to the field survey become mandatory.

The original *Neurological Disorders in Central Spain*, first survey (NEDICES-1) was a closed population-based study, which followed a cohort over 13 years [2,3,11,12]. The NEDICES has produced high-quality epidemiological research on different neurological disorders with >70 peer-reviewed publications regarding stroke, dementia, parkinsonism, tremor, and various aspects of aging and mortality. The main limitation of the NEDICES-1 was the few laboratory data we obtained from participants; to overcome this limitation, we have established a new observational survey, the *Neurological Disorders in Central Spain*, second survey (NEDICES-2).

The main differences between the NEDICES-1 and NEDICES-2 are the following. First, in the NEDICES-2, we selected participants through primary care physicians, instead of using the census as in the NEDICES-1. Currently, the Spanish National Health System includes virtually all Spanish legal residents and immigrants. We used computerized data of citizens assigned to primary care physicians because they perform their clinical work at Spanish National Health System centers. Second, this new cohort of participants comprises subjects aged >54 years. The younger cohort was not included in the original survey. Third, a tissue bank (biobank) of participants was created. Fourth, the study areas were not the same as those of the previous NEDICES survey, although similarly located in central Spain. Finally, in the NEDICES-2, the computerized registry of clinical and biological data is centralized in a specific website.

The main objective of our pilot study was to evaluate all major aspects of the NEDICES-2 survey (methods, database, screening instruments, and questionnaires, as well as interexpert rating of

neurological diagnoses) and to test the possibility of obtaining biological samples from each participant. Another important objective of this pilot study was to assess the levels of cooperation among potential participants and identify and resolve newly arising problems.

Methods

Design

The coordinating center (Research Institute of the University Hospital "12 Octubre" in Madrid) of the NEDICES-2 designed all aspects of the survey during 2011-2012, advised by participating primary care physicians. The methods and protocols were analogous to the NEDICES-1 survey [2,3,11,12].

Objectives

The NEDICES-2 survey aims to establish a population-based cohort to investigate major age-related neurological disorders (essential tremor, Parkinsonism, stroke, mild cognitive impairment [MCI], and dementia), including the risk factors and possible biomarkers for such neurological diseases. In addition, we aim to confirm the general findings of the NEDICES-1 survey with a new larger cohort, including persons in late adulthood (age 55-64 years) and to assess the possible changes in the neurological diseases incidence over time. Finally, one important aim of this study is to obtain biological samples (blood, urine, hair, and saliva).

Population and Study Areas (Pilot Study Selection)

The NEDICES-2 survey aims for a baseline cohort population of approximately 8000 participants; this number was calculated to adequately detect Parkinson disease, which has the lowest prevalence and incidence of all neurological disorders studied in this research [13,14]. We expect a similar attrition as happened in the NEDICES-1 survey [12]. The areas were selected to represent rural, semirural, and urban populations.

The composition by age reflects the general Spanish population aged >54 years (30% in the strata of 55-64 years); this age composition is like other European cohorts such as the Rotterdam study [15]. The NEDICES-2 population will be selected from primary care physicians' lists to obtain a random group (400-600 subjects per primary care physician's list) representative for age (5-year strata) and sex of subjects aged 55-84 years and of all subjects aged >84 years.

The coordinating center of the NEDICES-2 set up the pilot field study and selected the study protocol (questionnaires, scales, and examinations) with few differences from the NEDICES-1 survey. Furthermore, it developed the telematic utilities for the survey—specific email, Skype conferences, information website, and an electronic platform—to collect study data with privacy requirements. The coordinating center also conducted the pilot study.

The coordinating center selected 7 areas to survey participants for the pilot study: Fuentelarreina and Comillas (central Madrid), Las Margaritas (Getafe, peripheral Madrid), Arganda del Rey (suburban Madrid, semirural area), Cantalejo (Segovia, rural area), Burgos county (rural area), Arévalo (Ávila, semirural area), and Pizarrales (Salamanca, urban area). The participants were randomly selected (choosing 5 of 20) and stratified by sex and age (in 5-year age spans) to be evaluated by 7 primary care physicians. Participants were considered eligible if they had lived in rural or urban areas for >6 months and did not anticipate a serious illness that could cause death within the next year. In addition, for this pilot study, we recruited patients from the outpatient neurology clinics of both the University Hospital “12 de Octubre” in Madrid and the Burgos University Hospital in Burgos. These comprised patients diagnosed with the following neurological disorders: essential tremor, Parkinsonism, stroke, headache, MCI, and dementia.

Questionnaires and Screening Methods

We administered 3 different types of questionnaires. First, lay interviewers (mostly students, not in medicine) administered general questionnaires, including information on the demographic and social aspects of participants. In addition, these questionnaires included screening questions (see below) or brief neuropsychological batteries for detecting or confirming neurological diseases, such as essential tremor [16-18], Parkinsonism [13,14,19], stroke [20,21], or MCI or dementia (37-item version of the Mini-Mental State Examination, clock drawing test, 11-item version of the Pfeffer Functional Activities Questionnaire, Word Accentuation test, verbal fluency [animals and fruits], Trail-Making test, delayed late memory tests, logical memory, and nomenclature and images) [22-27], which had been used in the NEDICES-1. Second, primary care physicians also administered a questionnaire with anthropometric data, general health status, cardiovascular risk factors, previous illnesses, clinical comorbidity [28], and current medications. Furthermore, primary care physicians took standard biochemical specimens (blood and urine) for registration and for the biobank (in some cases, hair and saliva were also included). Finally, a self-reported questionnaire was also completed by each study participant, providing personal data, professional background, education and studies, measurements of subjective health (global, age-comparative, and time-comparative self-rated health) [29], generic health-related quality of life (European Quality of Life Scale) [30], Epworth sleepiness scale [31], physical activity [32], headaches [33], the Beck Depression Inventory scale [34], social relationships of participants, and information about their lifestyle (drugs, tobacco, coffee, and alcohol consumption).

Screening methods for the main neurological disorders were like those used in the NEDICES-1 survey [2,3,11,12]. A random sample of approximately 4% of those who had screened negative in the NEDICES-1 was selected and contacted to assess the performance of these screening methods [1]. Of 205 subjects who were contacted, 183 were successfully scheduled for a neurological examination by a senior neurologist [1]; they all were examined, and none was found to have essential tremor, parkinsonism, or stroke; however, 1.1% (2/183) of subjects were found to have “mild dementia” (95% CI 0.3%-3.9%) [1].

In the NEDICES-1, we included a question for essential tremor (“have you ever suffered from tremor of the head, hands, or legs that has lasted longer than several days?”) [17,18]. In addition, 3 questions were administered to screen for parkinsonism (questions about the previous diagnosis of Parkinson disease, tremor, and bradykinesia) [13,14]. Furthermore, we used a validated 9-item questionnaire aimed at identifying parkinsonism-related symptoms [19]. The screening instrument for stroke was a Spanish adaptation of the questionnaire used for screening in the World Health Organization Multinational Monitoring of Trends and Determinants in Cardiovascular disease project [35]. The main screening instruments for MCI or dementia included the Spanish adaptation of a cognitive test (a 37-item version of the Mini-Mental State Examination) and an instrumental activity of daily living scale (11-item version of the Pfeffer Functional Activities Questionnaire) [22,24]. The sensitivities of both the 37-item version of the Mini-Mental State Examination and the Pfeffer Functional Activities Questionnaire Scale are >90% [36].

Ethical Aspects

All participants included in the study gave their written informed consent after full explanation of the procedure. The study, which was conducted in accordance with the principles of the 1975 Declaration of Helsinki, was approved by the ethical standards committee on human experimentation at the University Hospital “12 de Octubre” (Madrid). Written (signed) informed consent was obtained from all enrollees. The data collection and biobank procedures conformed to the Spanish law.

Statistical Analyses

Statistical analyses were performed using SPSS Version 21.0 (IBM Corp). All tests were 2-sided, and the significance was accepted at the 5% level ($\alpha=.05$). Continuous variables were compared using Mann-Whitney *U* test because they were all nonnormally distributed. Furthermore, chi-square test was used to analyze categorical variables.

Results

Population

Figure 1 shows the flowchart of the study. The originally selected population for the pilot study was of 567 participants. Of them, 34.6% (196/567) were recruited from the outpatient neurology clinics of both the University Hospital “12 de Octubre” in Madrid, which provided 168 patients with neurological diseases and 22 patients without them after a careful examination, and the Burgos University Hospital in

Burgos, which provided 6 patients with neurological diseases. The remaining 65.4% (371/567) participants were selected from primary care physicians' lists of the study areas.

Of the subjects recruited from hospitals, 13.3% (26/196) refused to participate; meanwhile, 86.7% (170/196) were adequately evaluated (complete data and assessment by a neurologist). Of the 371 participants selected from primary care physicians' lists, 8.3% (31/371) were excluded because of change of primary care physician, change of address, and deaths. Of the remaining 340 who were eligible by the primary care physician assessment, 15.9% (54/340) were excluded because of inadequate evaluation (institutionalization, unreachable, refusals, and severe diseases). The remaining 286 fulfilled or were administered the questionnaires, but 15.4% (44/286) were excluded because of incomplete data. Finally, 242 participants had complete data; however, only 57.9% (140/242) participants were eligible for

the final analyses because neurologists could not evaluate 42.1% (102/242) for several reasons.

Thus, the final sample consisted of 310 participants (61.3%, 190/310, with neurological diseases and 38.7%, 120/310, without them) who presented all the required data (3 questionnaires, neurological evaluation, and biobank donation; Table 1). A higher proportion of participants with neurological diseases were more likely to have depression or depressive symptoms, cataracts, and score worse on screening tests for cognitive disorders (37-item version of the Mini-Mental State Examination and 11-item version of the Pfeffer Functional Activities Questionnaire). In addition, as expected, they scored higher in the Parkinson disease screening test and rated their health as bad or very bad. On the other hand, they were more likely to be more sedentary. Table 2 shows the final sample of participant distribution according to neurologists' diagnosis.

Figure 1. Flow chart of the Neurological Disorders in Central Spain, second survey (NEDICES-2), feasibility pilot study.

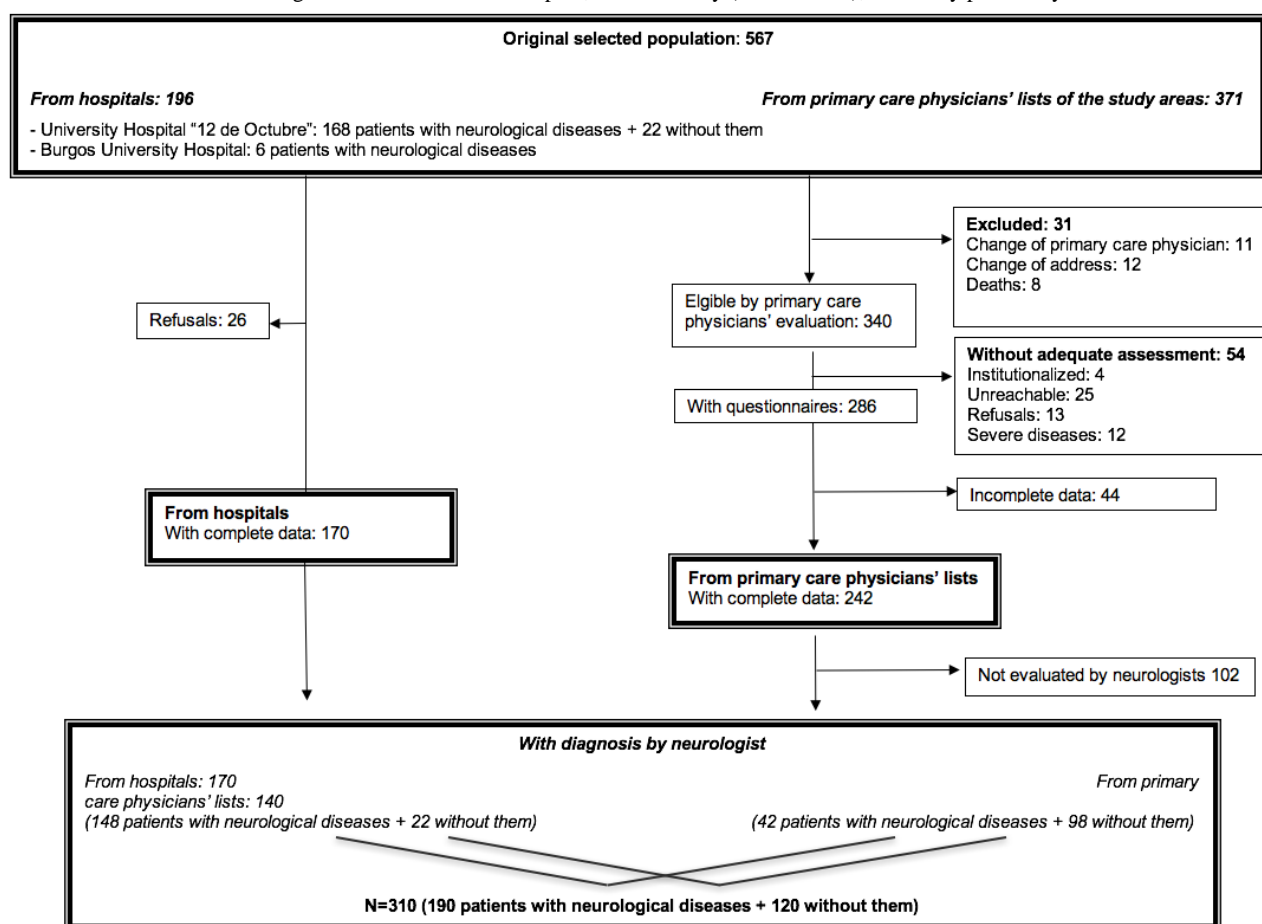


Table 1. Baseline demographics and a selection of clinical characteristics of the final sample of participants (N=310).

Characteristics	Without neurological diseases (n=120 ^a)	With neurological diseases (n=190 ^{b,c})	P value ^d
Age (years), mean (SD); median	70.7 (9.4); 69	71.7 (9.4); 73	.28
Sex, n (%)			.92
Men	55 (45.8)	86 (45.3)	
Women	65 (54.2)	104 (54.7)	
Years of education in years ^e , mean (SD); median	9.9 (5.6); 8.0	8.4 (5.2); 8.0	.52
Main nonneurological disorders^e, n (%)			
Diabetes	21 (18.4)	38 (20.7)	.64
Arterial hypertension	62 (53.9)	99 (53.5)	.95
Hypercholesterolemia	56 (48.3)	87 (47.0)	.83
Heart diseases	20 (20.4)	34 (22.2)	.73
Osteoarthritis	59 (51.8)	95 (52.5)	.90
Cancer	18 (16.1)	22 (12.2)	.35
Cataracts	30 (26.3)	74 (41.8)	.007
Chronic pulmonary disease	16 (14.3)	25 (13.7)	.90
Depression	17 (14.9)	50 (27.6)	.011
Deafness	17 (15.2)	57 (31.5)	.002
Lifestyle variables^e			
Sleeping hours, mean (SD); median	7.0 (1.4); 7.0	7.2 (1.6); 7.0	.47
Ever smoker (ex-smoker plus current smoker), n (%)	1 (11.3)	11.0 (8.9)	.12
Ever drinker (ex-drinker plus current drinker), n (%)	67 (57.3)	103 (54.8)	.67
Physical activity, n (%)			.004
Inactive	60 (52.2)	130 (69.1)	
Moderately inactive	6 (5.2)	15 (8.0)	
Moderately active	22 (19.1)	20 (10.6)	
Active	27 (23.5)	23 (12.2)	
Self-rated health^e, n (%)			.01
Very good	15 (12.8)	8 (4.2)	
Good	55 (47.0)	72 (38.1)	
Fair	41 (35.0)	94 (49.7)	
Poor	5 (4.3)	13 (6.9)	
Very poor	1 (0.9)	2 (1.1)	
Screening tests for cognitive disorders^e, mean (SD); median			
37-item version of the Mini-Mental State Examination	32.2 (4.8); 33.0	30.7 (5.7); 32.0	.02
11-item version of the Pfeffer Functional Activities Questionnaire	1.1 (4.0); 0	3.2 (6.0); 0	<.001
Parkinson disease screening test, mean (SD); median	1.0 (1.2); 1.0	2.8 (2.4); 2.0	<.001
Headache (yes vs no), n (%)	29 (27.4)	57 (34.3)	.26
Beck Depression Inventory scale, mean (SD); median	7.1 (5.6); 6.0	9.7 (6.3); 9.0	<.001

^a98 from hospitals + 22 from primary care physicians' lists.^b148 from hospitals + 42 from primary care physicians' lists.^c15 patients had more than one disorder.

^dContinuous variables were compared using the Mann-Whitney *U* test because they were all nonnormally distributed. Furthermore, the chi-square test was used to analyze categorical variables.

^eData on some participants were missing.

Table 2. Final participant sample (N=310) distribution according to neurologists' diagnosis.

Characteristics	Without neurological diseases (n=120)	With neurological diseases ^a (n=190)					
		Headache (n=37)	Dementia (n=28)	Parkinson disease (n=35)	Stroke (n=43)	Mild cognitive impairment (n=23)	Essential tremor (n=39)
Age (years), mean (SD)	70.1 (9.6)	66.4 (10.5)	78.2 (6.8)	71.5 (10.2)	71.1 (8.4)	75.6 (6.5)	71.4 (8.1)
Gender, n (%)							
Men	55 (45.8)	14 (37.8)	11 (39.3)	21 (60.0)	23 (53.5)	12 (52.2)	14 (35.9)
Women	65 (54.2)	23 (62.2)	17 (60.7)	14 (40.0)	20 (46.5)	11 (47.8)	25 (64.1)

^aFifteen participants had more than one disorder.

All selected areas participated in the survey (participant evaluation and acquisition of biological samples), but the quality of the information obtained and the clinical workload for primary care physicians was quite varied, as was the biobank established in each local area. Primary care physicians of Arganda del Rey, Las Margaritas (Madrid), and Pizarrales (Salamanca) had difficulties carrying out the survey because of high clinical load, and therefore, they refused to participate in this pilot study; these areas were then replaced by La Alamedilla (Salamanca, urban area), Calesas, (urban area, Madrid), Valladolid (urban area), and Cantalejo (rural area, Segovia).

Development of the Pilot Study

Each primary care physician invited selected subjects from among his or her patient list to join in the survey through a phone call or a letter. The duration of the interviews with participants was variable (10-20 minutes). Most participants signed the informed consent for both clinical participation and donation to biobanks. The pilot study showed that the central biobank faced practical difficulties such as shortage of staff, high costs, and difficulties with sample arrangements in the University Hospital "12 de Octubre" biobank. The coordinating center overcame this problem by changing the initial survey design to use local biobanks as supplements to the central biobank (except for Madrid, Ávila, and Segovia).

The training of interviewers was satisfactory. Interviewer questionnaires were digitized and sent to the central website. Most of the participants' self-report questionnaires had to be completed on paper and sent to the coordinating center in this format. Evaluations by lay interviewers lasted approximately 1 hour and 15 minutes, sometimes up to 3 hours, with a break. Participants with possible neurological disorders received a second evaluation performed by a neurologist.

The comprehension of questionnaires was generally adequate, with some exceptions. The Beck Depression Inventory scale [34] was difficult to understand for many participants, and the coordinating center replaced it by the Center for Epidemiologic Studies Depression Scale [37] for the future field study. The 37-item version of the Mini-Mental State Examination, 11-item version of the Pfeffer Functional Activities Questionnaire, Word Accentuation test, verbal fluency, Trail-Making test, delayed

late memory tests, logical memory, and nomenclature and images [22-25] allowed us to establish the psychometric cuts for screening for dementia, obtaining sensitivity >95% with high specificity.

Once the pilot study was completed, it was decided to compile each subject's evaluations; these summary sheets were sent to each primary care physician for them to discuss with each subject, explain the results obtained, and thank them for their collaboration.

Interrater Agreement in the Clinical Diagnosis of Neurologists Who Will Participate in the Field Study

The interrater agreement of cognitive status and tremor disorders have been published elsewhere [16,38]. Briefly, to assess the diagnostic agreement of cognitive status (dementia, MCI, and normal cognition) among neurologists, medical histories of 30 individuals were provided to 27 neurologists (19 consultant neurologists and 8 neurology residents) [38]. Overall, the interrater agreement on cognitive status was $\kappa=.76$ (95% CI 0.65-0.86), being slightly higher among junior neurologists ($\kappa=.85$, 95% CI 0.73-0.95) than among seniors ($\kappa=.71$, 95% CI 0.59-0.83) and residents ($\kappa=.69$, 95% CI 0.54-0.81), but without statistical significance among groups [38]. Dementia severity showed an overall kappa of .34, .44, and .64 for mild, moderate, and severe dementia, respectively [38]. Furthermore, clinical histories and standardized videotaped neurological examinations of 26 individuals (11 with essential tremor, 7 with Parkinson disease, 3 diagnostically unclear, 4 normal, and 1 with a tremor disorder other than essential tremor) were provided to 7 consultant neurologists, 6 neurology residents, and 5 neurology research fellows. For each of the 26 individuals, neurologists were asked to assign a diagnosis of "essential tremor" or "no essential tremor" using the diagnostic criteria proposed by the Movement Disorders Society [39]. The overall kappa was .61 (substantial agreement), with no differences among consultant neurologists ($\kappa=.60$), neurology residents ($\kappa=.61$), and neurology research fellows ($\kappa=.66$) in subgroup analyses [16].

Discussion

A pilot study is the first step in many types of epidemiological studies such as cross-sectional and longitudinal surveys [2-5,9],

case-control studies [40], and research investigations [41]. It is unwise to establish a complex survey without an adequate pilot study, as was demonstrated by this study.

Participants, in general, were more cooperative than expected. The main difficulties in the study were unexpected. Specifically, the study was time consuming for primary care physicians, as they had to explain it to participants, obtain informed consents, and complete a summary of their medical history. However, during the design of the NEDICES-2 survey, the coordinating center had erroneously considered that the 3 tasks could be performed in 10 minutes because the lay interviewer had given written information to participants and because there was a specific website with an explanation of the study.

Primary care physicians have a heavy workload in Spain. Many participants required a lengthy explanation of the survey, despite the good explanation on the website. With the public funds that we obtained, we could pay external collaborators as interviewers, but the Spanish National Health System research policy does not permit payment to primary care physicians, even if they devote extra time beyond their working hours. All this caused 3 primary care physicians' teams to leave this study. Thus, the coordinating center had to replace these primary care physicians' study areas by others, even in other geographical areas, to overcome this problem.

Another important difficulty was obtaining biological samples to establish the central biobank at the University Hospital "12 de Octubre" in Madrid. The pilot study showed that the only

possible way to address this problem was to send all biological samples to each local Spanish National Health System hospital laboratory (for registration and to establish a local biobank). Otherwise, the pilot study was successful, partly because the methods were analogous to the NEDICES-1. Only a few changes in the screening questionnaires and scales were made after the pilot survey. Moreover, several tests were established for the detection of MCI and dementia.

Substantial agreement was demonstrated for the diagnosis of cognitive status (dementia, MCI, and normal cognition) among neurologists of different levels of experience [38]. The agreement rate was lower in the diagnosis of dementia severity. With respect to tremor disorders, substantial agreement was also demonstrated for the diagnosis of essential tremor among neurologists of different levels of expertise [16]. However, the agreement was lower than that previously reported using the Washington Heights-Inwood Genetic Study of Essential Tremor criteria [42].

In conclusion, we feel that it is impossible to undertake a large and complex neuroepidemiology survey, such as the NEDICES-2, without a pilot study. It is mandatory first to test the feasibility of all aspects of a future field study—population selection, methods, instruments to be used, neurological diagnosis agreement, and data collection. This pilot study reveals some serious deficiencies in the selected areas (the ability of overburdened primary care physicians to collaborate) and the biological bank configuration that could be solved by the coordinating center.

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Conflicts of Interest

None declared.

References

1. Anderson DW, Rocca WA, Rosário JA. Pitfalls in neuroepidemiologic research. *Neuroepidemiology* 1998;17(2):55-62. [doi: [10.1159/000026153](https://doi.org/10.1159/000026153)] [Medline: [9592780](https://pubmed.ncbi.nlm.nih.gov/9592780/)]
2. Bermejo F, Gabriel R, Vega S, Morales JM, Rocca WA, Anderson DW, Neurological Disorders in Central Spain (NEDICES) Study Group. Problems and issues with door-to-door, two-phase surveys: an illustration from central Spain. *Neuroepidemiology* 2001 Oct;20(4):225-231. [doi: [10.1159/000054794](https://doi.org/10.1159/000054794)] [Medline: [11684897](https://pubmed.ncbi.nlm.nih.gov/11684897/)]
3. Morales JM, Bermejo FP, Benito-León J, Rivera-Navarro J, Trincado R, Gabriel SR, NEDICES Study Group. Methods and demographic findings of the baseline survey of the NEDICES cohort: a door-to-door survey of neurological disorders in three communities from Central Spain. *Public Health* 2004 Sep;118(6):426-433. [doi: [10.1016/j.puhe.2003.10.007](https://doi.org/10.1016/j.puhe.2003.10.007)] [Medline: [15313596](https://pubmed.ncbi.nlm.nih.gov/15313596/)]
4. Katsarava Z, Kukava M, Mirvelashvili E, Tavadze A, Dzagnidze A, Djibuti M, et al. A pilot methodological validation study for a population-based survey of the prevalences of migraine, tension-type headache and chronic daily headache in the country of Georgia. *J Headache Pain* 2007 Apr;8(2):77-82 [FREE Full text] [doi: [10.1007/s10194-007-0367-x](https://doi.org/10.1007/s10194-007-0367-x)] [Medline: [17497261](https://pubmed.ncbi.nlm.nih.gov/17497261/)]
5. Bower JH, Mwendo E, Walker R, Maro V, Enquosellase F, Ali S. Validity of a screening instrument for neurologic disability in resource-poor African communities. *J Neurol Sci* 2012 Sep 15;320(1-2):52-55 [FREE Full text] [doi: [10.1016/j.jns.2012.06.007](https://doi.org/10.1016/j.jns.2012.06.007)] [Medline: [22795389](https://pubmed.ncbi.nlm.nih.gov/22795389/)]

6. Rodríguez LA, Urdaneta AE, de la Fuente Sánchez M, Galindo ME, Yanguas LJJ, Rodríguez RV. [Analysis of selection bias in the pilot study of a longitudinal study on aging in Spain]. *Gac Sanit* 2013;27(5):425-432 [[FREE Full text](#)] [doi: [10.1016/j.gaceta.2012.11.008](#)] [Medline: [23291032](#)]
7. Boden-Albala B, Edwards DF, St Clair S, Wing JJ, Fernandez S, Gibbons MC, et al. Methodology for a community-based stroke preparedness intervention: the Acute Stroke Program of Interventions Addressing Racial and Ethnic Disparities Study. *Stroke* 2014 Jul;45(7):2047-2052 [[FREE Full text](#)] [doi: [10.1161/STROKEAHA.113.003502](#)] [Medline: [24876243](#)]
8. Exley K, Aerts D, Biot P, Casteleyn L, Kolossa-Gehring M, Schwedler G, et al. Pilot study testing a European human biomonitoring framework for biomarkers of chemical exposure in children and their mothers: experiences in the UK. *Environ Sci Pollut Res Int* 2015 Oct;22(20):15821-15834. [doi: [10.1007/s11356-015-4772-4](#)] [Medline: [26036586](#)]
9. Dai J, Chiu HFK, Xiang Y, Chan SSM, Yu X, Hou Z, et al. The prevalence of insomnia and its socio-demographic and clinical correlates in older adults in rural China: a pilot study. *Aging Ment Health* 2013;17(6):761-765. [doi: [10.1080/13607863.2013.781117](#)] [Medline: [23547946](#)]
10. Nelson LM, Tanner CM, Van Den Eeden SK, McGuire VM. *Neuroepidemiology: From Principles to Practice*. New York: Oxford University Press; 2004:019513379.
11. Bermejo-Pareja F, Benito-León J, Vega- Q, Díaz-Guzmán J, Rivera-Navarro J, Molina JA, et al. The NEDICES cohort of the elderly. Methodology and main neurological findings. *Rev Neurol* 2008;46(7):416-423 [[FREE Full text](#)] [Medline: [18389461](#)]
12. Vega S, Benito-León J, Bermejo-Pareja F, Medrano MJ, Vega-Valderrama LM, Rodríguez C, et al. Several factors influenced attrition in a population-based elderly cohort: neurological disorders in Central Spain Study. *J Clin Epidemiol* 2010 Feb;63(2):215-222. [doi: [10.1016/j.jclinepi.2009.03.005](#)] [Medline: [19473811](#)]
13. Benito-León J, Bermejo-Pareja F, Rodríguez J, Molina J, Gabriel R, Morales J, Neurological Disorders in Central Spain (NEDICES) Study Group. Prevalence of PD and other types of parkinsonism in three elderly populations of central Spain. *Mov Disord* 2003 Mar;18(3):267-274. [doi: [10.1002/mds.10362](#)] [Medline: [12621629](#)]
14. Benito-León J, Bermejo-Pareja F, Morales-González JM, Porta-Etessam J, Trincado R, Vega S, Neurological Disorders in Central Spain (NEDICES) Study Group. Incidence of Parkinson disease and parkinsonism in three elderly populations of central Spain. *Neurology* 2004 Mar 09;62(5):734-741. [Medline: [15007123](#)]
15. Hofman A, Brusselle GGO, Darwish Murad S, van Duijn CM, Franco OH, Goedegebure A, et al. The Rotterdam Study: 2016 objectives and design update. *Eur J Epidemiol* 2015 Aug;30(8):661-708 [[FREE Full text](#)] [doi: [10.1007/s10654-015-0082-x](#)] [Medline: [26386597](#)]
16. Sierra-Hidalgo F, Romero JP, Bermejo-Pareja F, Sánchez-Ferro A, Hernández-Gallego J, Posada IJ, et al. Inter-Rater Agreement in the Clinical Diagnosis of Essential Tremor: Data from the NEDICES-2 Pilot Study. *Tremor Other Hyperkinet Mov (N Y)* 2014;4 [[FREE Full text](#)] [doi: [10.7916/D8JD4TQ0](#)] [Medline: [24587969](#)]
17. Benito-León J, Bermejo-Pareja F, Morales J, Vega S, Molina J. Prevalence of essential tremor in three elderly populations of central Spain. *Mov Disord* 2003 Apr;18(4):389-394. [doi: [10.1002/mds.10376](#)] [Medline: [12671944](#)]
18. Benito-León J, Bermejo-Pareja F, Louis ED, Neurological Disorders in Central Spain (NEDICES) Study Group. Incidence of essential tremor in three elderly populations of central Spain. *Neurology* 2005 May 24;64(10):1721-1725. [doi: [10.1212/01.WNL.0000161852.70374.01](#)] [Medline: [15911798](#)]
19. Sevillano MD, de Pedro-Cuesta J, Duarte J, Clavería LE. Field validation of a method for population screening of parkinsonism. *Mov Disord* 2002 Mar;17(2):258-264. [Medline: [11921110](#)]
20. Díaz-Guzmán J, Bermejo-Pareja F, Benito-León J, Vega S, Gabriel R, Medrano MJ, Neurological Disorders in Central Spain (NEDICES) Study Group. Prevalence of stroke and transient ischemic attack in three elderly populations of central Spain. *Neuroepidemiology* 2008;30(4):247-253. [doi: [10.1159/000135643](#)] [Medline: [18515974](#)]
21. Martínez-Salio A, Benito-León J, Díaz-Guzmán J, Bermejo-Pareja F. Cerebrovascular disease incidence in central Spain (NEDICES): a population-based prospective study. *J Neurol Sci* 2010 Nov 15;298(1-2):85-90. [doi: [10.1016/j.jns.2010.08.003](#)] [Medline: [20817180](#)]
22. Contador I, Bermejo-Pareja F, Fernández-Calvo B, Boycheva E, Tapias E, Llamas S, et al. The 37 item Version of the Mini-Mental State Examination: Normative Data in a Population-Based Cohort of Older Spanish Adults (NEDICES). *Arch Clin Neuropsychol* 2016 May;31(3):263-272. [doi: [10.1093/arcclin/acw003](#)] [Medline: [26860862](#)]
23. Contador I, Bermejo-Pareja F, Del Ser T, Benito-León J. Effects of education and word reading on cognitive scores in a community-based sample of Spanish elders with diverse socioeconomic status. *J Clin Exp Neuropsychol* 2015;37(1):92-101. [doi: [10.1080/13803395.2014.989819](#)] [Medline: [25686369](#)]
24. Louis ED, Benito-León J, Vega-Quiroga S, Bermejo-Pareja F, Neurological Disorders in Central Spain (NEDICES) Study Group. Cognitive and motor functional activity in non-demented community-dwelling essential tremor cases. *J Neurol Neurosurg Psychiatry* 2010 Sep;81(9):997-1001. [doi: [10.1136/jnnp.2009.202838](#)] [Medline: [20547612](#)]
25. Serna A, Contador I, Bermejo-Pareja F, Mitchell AJ, Fernández-Calvo B, Ramos F, et al. Accuracy of a Brief Neuropsychological Battery for the Diagnosis of Dementia and Mild Cognitive Impairment: An Analysis of the NEDICES Cohort. *J Alzheimers Dis* 2015;48(1):163-173. [doi: [10.3233/JAD-150086](#)] [Medline: [26401937](#)]

26. Bermejo-Pareja F, Benito-León J, Vega S, Olazarán J, de Toledo M, Díaz-Guzmán J, et al. Consistency of clinical diagnosis of dementia in NEDICES: A population-based longitudinal study in Spain. *J Geriatr Psychiatry Neurol* 2009 Dec;22(4):246-255. [doi: [10.1177/0891988709335794](https://doi.org/10.1177/0891988709335794)] [Medline: [19417217](https://pubmed.ncbi.nlm.nih.gov/19417217/)]
27. Bermejo-Pareja F, Benito-León J, Vega S, Medrano MJ, Román GC, Neurological Disorders in Central Spain (NEDICES) Study Group. Incidence and subtypes of dementia in three elderly populations of central Spain. *J Neurol Sci* 2008 Jan 15;264(1-2):63-72. [doi: [10.1016/j.jns.2007.07.021](https://doi.org/10.1016/j.jns.2007.07.021)] [Medline: [17727890](https://pubmed.ncbi.nlm.nih.gov/17727890/)]
28. Carey IM, Shah SM, Harris T, DeWilde S, Cook DG. A new simple primary care morbidity score predicted mortality and better explains between practice variations than the Charlson index. *J Clin Epidemiol* 2013 Apr;66(4):436-444 [FREE Full text] [doi: [10.1016/j.jclinepi.2012.10.012](https://doi.org/10.1016/j.jclinepi.2012.10.012)] [Medline: [23395517](https://pubmed.ncbi.nlm.nih.gov/23395517/)]
29. Fernández-Ruiz M, Guerra-Vales JM, Trincado R, Fernández R, Medrano MJ, Villarejo A, et al. The ability of self-rated health to predict mortality among community-dwelling elderly individuals differs according to the specific cause of death: data from the NEDICES cohort. *Gerontology* 2013;59(4):368-377 [FREE Full text] [doi: [10.1159/000348781](https://doi.org/10.1159/000348781)] [Medline: [23615509](https://pubmed.ncbi.nlm.nih.gov/23615509/)]
30. EuroQol G. EuroQol--a new facility for the measurement of health-related quality of life. *Health Policy* 1990 Dec;16(3):199-208. [Medline: [10109801](https://pubmed.ncbi.nlm.nih.gov/10109801/)]
31. Johns MW. A new method for measuring daytime sleepiness: the Epworth sleepiness scale. *Sleep* 1991 Dec;14(6):540-545. [Medline: [1798888](https://pubmed.ncbi.nlm.nih.gov/1798888/)]
32. Puig RA, Peña CO, Romaguera BM, Duran BE, Heras TA, Solà GM, et al. [How to identify physical inactivity in primary care: validation of the Catalan and Spanish versions of 2 short questionnaires]. *Aten Primaria* 2012 Aug;44(8):485-493 [FREE Full text] [doi: [10.1016/j.aprim.2012.01.005](https://doi.org/10.1016/j.aprim.2012.01.005)] [Medline: [22463945](https://pubmed.ncbi.nlm.nih.gov/22463945/)]
33. Yoon M, Obermann M, Fritsche G, Slomke M, Dommies P, Schilf C, et al. Population-based validation of a German-language self-administered headache questionnaire. *Cephalalgia* 2008 Jun;28(6):605-608. [doi: [10.1111/j.1468-2982.2008.01560.x](https://doi.org/10.1111/j.1468-2982.2008.01560.x)] [Medline: [18422724](https://pubmed.ncbi.nlm.nih.gov/18422724/)]
34. Beck A, Ward C, Mendelson M, Mock J, Erbaugh J. An inventory for measuring depression. *Archives of general psychiatry* Jun 1961;4-71. [Medline: [13688369](https://pubmed.ncbi.nlm.nih.gov/13688369/)]
35. Asplund K. What MONICA told us about stroke. *Lancet Neurol* 2005 Jan;4(1):64-68. [doi: [10.1016/S1474-4422\(04\)00967-6](https://doi.org/10.1016/S1474-4422(04)00967-6)] [Medline: [15620858](https://pubmed.ncbi.nlm.nih.gov/15620858/)]
36. Baldereschi M, Amato MP, Nencini P, Pracucci G, Lippi A, Amaducci L, et al. Cross-national interrater agreement on the clinical diagnostic criteria for dementia. WHO-PRA Age-Associated Dementia Working Group, WHO-Program for Research on Aging, Health of Elderly Program. *Neurology* 1994 Feb;44(2):239-242. [Medline: [8309565](https://pubmed.ncbi.nlm.nih.gov/8309565/)]
37. Soler J, Pérez-Sola V, Puigdemont D, Pérez-Blanco J, Figueres M, Alvarez E. Validation study of the Center for Epidemiological Studies-Depression of a Spanish population of patients with affective disorders. *Actas Luso Esp Neurol Psiquiatr Cienc Afines* 1997;25(4):243-249. [Medline: [9412163](https://pubmed.ncbi.nlm.nih.gov/9412163/)]
38. Llamas-Velasco S, Sierra-Hidalgo F, Llorente-Ayuso L, Herrero-San MA, Villarejo GA, Bermejo PF. Inter-Rater Agreement in the Clinical Diagnosis of Cognitive Status: Data from the Neurological Disorders in Central Spain 2 Pilot Study. *Neuroepidemiology* 2016;47(1):32-37. [doi: [10.1159/000447699](https://doi.org/10.1159/000447699)] [Medline: [27398595](https://pubmed.ncbi.nlm.nih.gov/27398595/)]
39. Deuschl G, Bain P, Brin M. Consensus statement of the Movement Disorder Society on Tremor. *Ad Hoc Scientific Committee. Mov Disord* 1998;13 Suppl 3:2-23. [Medline: [9827589](https://pubmed.ncbi.nlm.nih.gov/9827589/)]
40. Beghi E, Logroscino G, Chiò A, Hardiman O, Millul A, Mitchell D, et al. Amyotrophic lateral sclerosis, physical exercise, trauma and sports: results of a population-based pilot case-control study. *Amyotroph Lateral Scler* 2010 May 03;11(3):289-292 [FREE Full text] [doi: [10.3109/17482960903384283](https://doi.org/10.3109/17482960903384283)] [Medline: [20433412](https://pubmed.ncbi.nlm.nih.gov/20433412/)]
41. Sewell DA, Hammersley VS, Devereux G, Robertson A, Stoddart A, Weir C, et al. Investigating the effectiveness of the Mediterranean diet in pregnant women for the primary prevention of asthma and allergy in high-risk infants: protocol for a pilot randomised controlled trial. *Trials* 2013 Jun 14;14:173 [FREE Full text] [doi: [10.1186/1745-6215-14-173](https://doi.org/10.1186/1745-6215-14-173)] [Medline: [23768094](https://pubmed.ncbi.nlm.nih.gov/23768094/)]
42. Louis ED, Ford B, Bismuth B. Reliability between two observers using a protocol for diagnosing essential tremor. *Mov Disord* 1998 Mar;13(2):287-293. [doi: [10.1002/mds.870130215](https://doi.org/10.1002/mds.870130215)] [Medline: [9539343](https://pubmed.ncbi.nlm.nih.gov/9539343/)]

Abbreviations

MCI: mild cognitive impairment

NEDICES-1: The Neurological Disorders in Central Spain, first survey

NEDICES-2: The Neurological Disorders in Central Spain, second survey

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